Number 53 June_ July 2016

Flightfax®

Online newsletter of Army aircraft mishap prevention information

There have been about a dozen Class A mishaps in the last 10 years where excessive maneuvering created a condition from which the aircraft could not be recovered and crashed into the ground. Recently, the Army suffered two Class A aviation accidents during combat maneuvering flight (CMF). Both accidents are eerily similar; both crews exceeded aircraft limitations for the environment they were operating in, and both initiated the aggressive maneuvers at low altitude and were unable to recover the aircraft before crashing. The major difference between the two mishaps was the fate of the crewmembers. One accident claimed the lives of all onboard, while the other crew survived. CMF is a complex task and, as stated in the Army Aviator's Handbook for Maneuvering Flight and Power Management, "If you haven't performed combat maneuvers in a while, start slowly. Much like NVD flying, your cross check slows and it will take some time to develop proficiency at tasks that have not been performed for extended periods of time."

As the Army continues the transition from wide area security to combined arms maneuver, units are focusing their training on defeating a near peer threat. Training to defeat advanced weapons systems requires a more aggressive training plan, and CMF is an integral part. Units must address all the complexities of CMF and ensure aviators fully understand the effects of environmental factors on aircraft performance and aerodynamic effects while maneuvering, while also increasing power management skills during these maneuvers. Prior to initiating CMF training, units should focus on instructing aviators in maneuvering flight and understanding aircraft limitations. This will give aviators a better understanding of their aircraft and its performance before conducting CMF.

Mission briefing officers and final mission approval authorities must also be trained on the complexities before briefing and approving CMF flights. A trained briefing officer will have the requisite skills and knowledge to ask the right questions, identify the hazards, and ensure the proper risk level and approving authority are assigned to the mission. CMF approved training flights must support individual and collective training tasks and can't be used as excuses to conduct ill-advised joyrides.

This issue of Flightfax focuses on CMF. It begins with an introductory article from DES that highlights the requirements and development of Task 2127, Perform Combat Maneuvering Flight, in the H60 Aircrew Training Manual. It then conducts two CMF mishap reviews, one from a more recent accident and one from the 1980s. The Flightfax Forum provides more insight into the complexity of the CMF task, gives some excellent tips for planning, and closes out with an excerpt from The Army Aviator's Handbook for Maneuvering Flight and Power Management. We've also included our traditional Blast from the Past and Selected Aircraft Mishap Briefs. The next edition of Flightfax will be focused on unmanned aerial systems.

Aviation Directorate
U.S. Army Combat Readiness Center
Fort Rucker, Ala.
(334) 255-3003/3530
DSN 558-3530

H60 Aircrew Training Manual
Task 2127 Perform Combat Maneuvering Flight
Just another 2000 Series Mission Task?

DAC Charles W. Lent
Directorate of Evaluation and Standardization
U.S. Army Aviation Center of Excellence
Fort Rucker, Ala.
H-60 SP/IE, Literature Review

Training Circular (TC) 3-04.33, Aircrew Training Manual (ATM), Task 2127 Perform Combat Maneuvering Flight, or CMF as it is commonly known, was developed and integrated into the Aircrew Training Manual as a 2000 series mission task in 2005. At the time, H60 aircrew members were fully engaged in Operation Iraqi Freedom and Operation Enduring Freedom performing challenging missions in harsh desert and mountain environments while operating aircraft at flight performance limits. As a direct result of accidents coupled with requirements to perform combat techniques and tactics, the CG, USAACE, BG E.J Sinclair, directed the Directorate of Evaluation and Standardization (DES) to develop a program to train units in the field on combat maneuvering in order to mitigate risk for Army aircrews. The goal of the training program was to ensure aviators involved in combat operations fully understood the effects of environmental factors on aircraft performance, aerodynamic effects while maneuvering, increase power management skills and instruct proper flight control inputs while performing flight maneuvers.

Due to the complexity of the task and inherent risk of flying the aircraft to performance limits, the H60 CMF training program was developed, planned and executed as a ***deliberate, moderate risk***, ***day-only training event.*** The training was solely conducted by DES standardization instructor pilots (SP) and included approximately 4.0 hours of academic training in addition to flight training the task maneuvers in the aircraft. Once trained in the task by DES, instructor pilots (IP) were authorized to train their unit in the “train the trainer concept.” The aerodynamic subjects included subjects required per the task - conservation of angular momentum, transient torque, torque in a turn, blade stall, and mushing in addition to power management. For two years DES made CMF part of the training menu available during unit assistance visits. It was apparent that DES could not train every IP in the Army and therefore a decision was made to integrate Task 2127 in the 2007 ATM as a 2000 series mission task allowing commanders to select the task based on their METL without requiring DES training for the IP. Task 2127 included **two warnings to convey the complexity and inherent risk associated with training this task and designated it a technical task to allow** for training and evaluation in the simulator to **ensure crawl, walk, run principle of training**. Since that time, there has been two Class A accidents where the results demonstrate a lack of proper training in the performance of the task. In both accidents, the pilot in command (PC) did not adhere to the warnings included in the task, exceeded aircraft bank angles and did not allow for adequate recovery altitude as well as initiate the maneuvers at cruise airspeeds at less than 500 feet AGL.

WARNING

Initial training should be conducted at sufficient altitudes to allow for longer recovery times due to uncoordinated flight control inputs and pilot experience. Helicopter flight performance based on the environmental and aircraft conditions must be the determining factor in selecting altitudes that ensure adequate room to recovery after maneuvering.

Continued on next page

Continued from previous page

WARNING
Excessive bank angles may not be sustainable with only the application of power. Airspeed (kinetic energy) or altitude (potential energy) may also not be available to trade for lift. These factors must be evaluated before and during the maneuver. Do not allow high sink rate to develop, as recovery altitude or power may not be available to recover. These conditions are aggravated as helicopter gross weight and density altitude increase.

Although Task 2127 is a selectable 2000 series mission task by the ATP commander, it is a very complex task that requires deliberate academic training as well as flight training that emphasizes aerodynamics, performance planning and aircrew coordination in order to mitigate risk.

Unit commanders must ensure that the aerodynamic subjects required by this task (conservation of angular momentum, transient torque, blade stall, and mushing) are part of the unit academic training program. These subjects are critical to proper training of this task. Once the academics are covered, the task may and should be trained in the simulator to build a scan and understand the aerodynamic effects on the aircraft while flying the maneuvers in the task. Many units develop an academic training program that is merely a listing of the minimum required academic subjects and many only list one annual class on aerodynamics. Units generally allow the instructor to decide the subject area and the requirements mandated by this task may be missed. SPs should be aware that the required subject areas to perform Task 2127 that were included in the "*The Army Aviator's Handbook for Maneuvering Flight and Power Management*" have been incorporated into FM 3-04.203 "*Fundamentals of Flight"* and are required in order to perform Task 2127, Perform Combat Maneuvering Flight. The aerodynamic subjects required by this task apply to many more tasks and should be part of a substantive academic program.

The complexity of Task 2127 requires active risk mitigation during the mission planning, briefing and approval process. If part of the unit METL, commanders should require Task 2127 Perform Combat Maneuvering Flight be included as a mandatory item on DA Form 5484-R and the unit risk assessment worksheet (RAW). Inclusion of this task will allow commanders to appropriately assess risk based on aircrew experience, recency and proficiency in performing the flight maneuvers included in the task. The unit mission approval and briefing process must ensure briefing officers ask the detailed performance questions and not just the minimum required questions specified in AR 95-1. The briefer must ensure the appropriate level of academic knowledge and compliance with the warnings in the tasks as well as set appropriate altitude, airspeed and training restrictions.

It is critical that mission briefers ask detailed performance planning and aircraft limitation questions to ensure active risk mitigation measures are in place in order for the approval process to be effective. VOCO authorization is not prohibited, but generally there is less interaction between the briefer and PC or air mission commander (AMC) receiving a briefing. While VOCO briefing is allowed, it should not be the norm based on the fact that it is nearly impossible to perform a detailed review and assess mission planning over a phone or through a third party. When the mission briefer does not review the details of a mission the required risk mitigation measures will not be applied and the intent of the process fails. Briefing officers are responsible for ensuring key mission elements are evaluated, briefed and understood by the PC or AMC. When a detailed mission briefing is not performed by an experienced PC the process fails - allowing aircrews and the command to assume more risk than necessary. In the case of Task 2127 the briefer is key to ensuring the risk controls are in place for the commander. The mission briefer must be able to

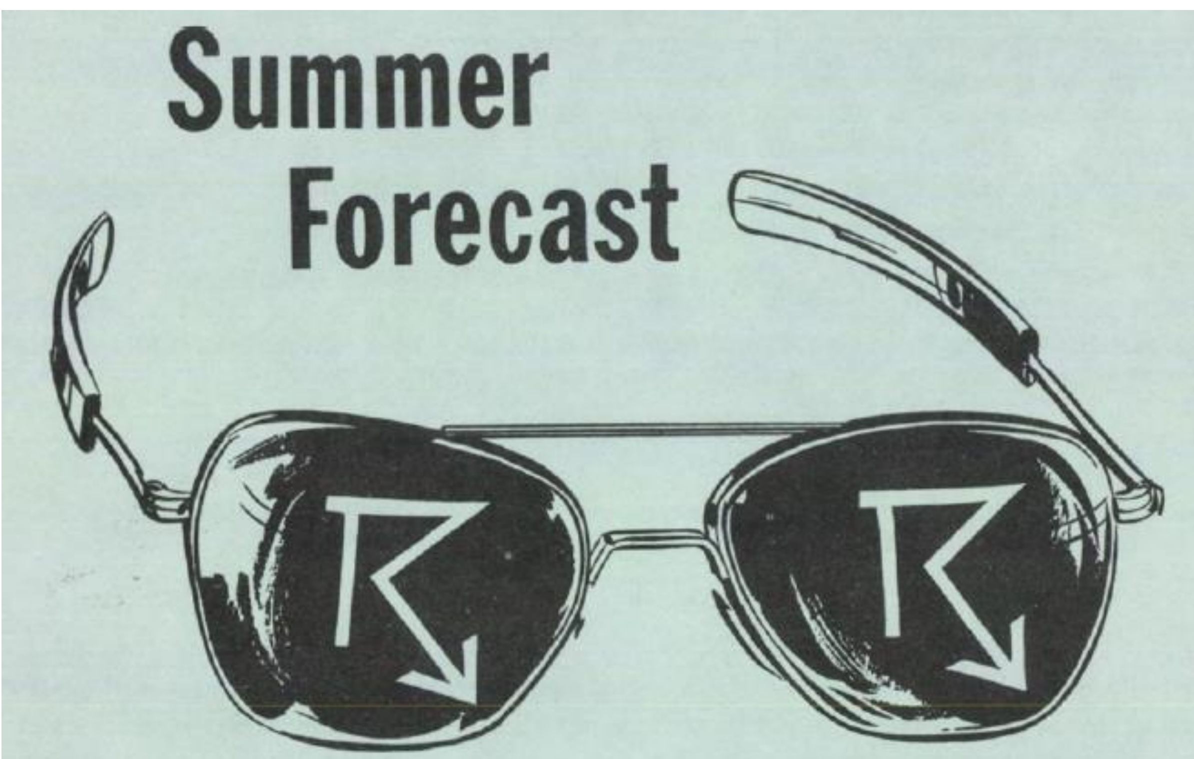
Continued on next page

Continued from previous page

mitigate risk in order break the chain of events that may lead to an aircraft accident while performing this or any other complex task. AR 95-1 states that a unit should limit the number of briefers and this is one of the reasons. Are your unit mission briefers authorized because they are PCs or do they possess the depth of knowledge and experience to ask the right questions?

The goal of the H60 combat maneuvering flight training program and the development of Task 2127 was to ensure aviators involved in combat operations **fully understood the effects of environmental factors on aircraft performance, aerodynamic effects while maneuvering and proper application of power management techniques at all times during the flight regime**. In recent years, the lack of emphasis on the academic subjects mandated by the task coupled with the lack of controls to effectively assess and mitigate risk have relegated this task to becoming just another 2000 series task required for RL progression. Commanders should assess their METL tasks and ensure this task is required, if so they must place emphasis on effective academic and flight training and ensure mitigation controls are in place to ensure aircrews operate within aircraft and aircrew capabilities. It is critical the appropriate risk level be assessed, risk mitigated effectively and accepted by the chain of command fully understanding the complexities and inherent risk associated with performing this complex maneuver.

--DAC Charles W. Lent may be contacted at (334) 255-9098, DSN 558.



Review your environmental challenges and performance planning.

Mishap Review: UH-60L Maneuvering Flight

On a RL progression training flight conducting combat maneuvering flight (CMF) training, the UH-60L descended to an altitude which resulted in the aircraft contacting a tree. The aircraft subsequently broke into two sections, destroying the aircraft and resulting in fatal injuries to all four crew members.

History of flight

The mission of the accident crew was to conduct pilot (PI) and crew chief (CE) readiness level (RL) progression training and local area orientation (LAO) for the left seat crew chief (CE) who was recently assigned to the unit. The crew reported for duty at 1500L. The IP and PI received the mission briefing with the mission briefing officer (MBO) and the final mission approval authority (FMAA). The FMAA approved the flight for day, night, night vision device (NVD), and terrain flight conditions for RL progression, annual proficiency and readiness test (APART), and continuation training. Combat maneuvers were identified as the highest risk, for which mitigation measures were to discuss aircraft limitations, procedures, and safe altitude considerations. The briefing officer and IP acknowledged the brief and mitigation strategies and the FMAA approved the mission as low risk. Weather: Sky clear visibility 10+, winds 140/04 knots, temp +12 C.

Preflight and runup were completed following the mission brief with the aircraft departing home station at 1700L. While en route to a local training site the IP identified landmarks, reporting points, and corridor altitude and airspeed requirements to the CE as part of the LAO. During the descent into terrain flight mode in the vicinity of the training site, the IP conducted a high reconnaissance and identified the area where the daytime portion of the training would be conducted. Between 1720 and 1725, the crew performed five RCM RL-2 maneuvers. On the sixth maneuver, the accident aircraft contacted a tree and crashed. The aircraft was destroyed and the four crew members were fatality injured.

Crewmember experience

The IP, sitting in the left seat, had 1,600 hours of total time, 1,400 in the UH-60L, 120 as an IP and 340 PC hours. The PI, operating from the right seat, had 1,160 hours total time, 1,000 in the UH-60 with 530 PC hours. The FI had a total of 1,800 hours with 145 as an FI. The CE had 2,300 hours total time with 500 SI hours and 120 FI.

Commentary

In performing combat maneuvering flight, helicopter flight performance, based on environmental and aircraft conditions, must be the determining factor in selecting altitudes that ensure adequate room to recover after maneuvering. Aircrews must be familiar with aerodynamic factors such as mushing, transient torque, and blade stall before performing these maneuvers. Excessive bank angles may not be sustainable with only the application of power. Airspeed or altitude may also not be available to trade for lift. These factors must be evaluated before and during the maneuver. Do not allow high sink rates to develop, as recovery altitude or power may not be available to recover. These conditions are aggravated as helicopter gross weight and density altitude increase.

Mishap Review: UH-60 Aerial Demonstration

This mishap occurred many years ago. During a day, low-level VMC flight demonstration, the UH-60A exceeded the flight limitations of the helicopter. The aircraft descended and the main rotor system of the aircraft struck the ground resulting in major injuries to personnel on board and total destruction of the aircraft.

History of flight

The mission of the accident crew was to conduct an aerial demonstration and static display at a nearby airbase. The aircraft relocated from home base to the display site the day prior. On the day of the mishap, the crew started the duty day at 1200 local with the PC conducting the preflight inspection and performance planning while the PI filed a local flight plan and obtained a weather briefing. Weather for the flight was minimum ceilings at 3,000 feet, visibility 10 miles, winds calm and temperature of 63 F.

At 1340 local, the aircraft repositioned to the runway for departure. The PC conducted a vertical takeoff climbing to 1,500 feet AGL followed by two 360-degree descending, spiraling turns to 700 feet AGL. Next, the PC conducted a high-speed, low-level pass ending with a cyclic climb, a negative G maneuver and a right break. Upon completion of the maneuver, the aircrew set up for its last maneuver, a high-speed, low-level pass with a 90-degree bank. The final pass was begun at approximately 110 feet AGL and 140 KIAS. Everything went as planned until the PC initiated the right bank. The aircraft went past the 90-degree bank point and the nose of the aircraft dropped abruptly. The PC applied full power and full left cyclic but the aircraft impacted the ground in a 40 degree nose high attitude and 20 degrees right roll. The initial point of impact was the right rear portion of the stabilator and the main rotor blades in the right rear quadrant. The aircraft slid and impacted a building. The six occupants remained in their seats throughout the crash sequence. All personnel survived with injuries and the aircraft was destroyed.

Crewmember experience

The pilot-in-command (PC) had 631 total hours with 313 in the UH-60A. The PI had 228 total hours with 63 hours in the UH-60A.

Commentary

The aircraft was operated in a manner which exceeded flight limitations in the operator's manual. The aircraft entered an uncoordinated right turn with a bank angle in excess of 90-degrees and in a nose-low attitude which exceeded the aircraft's capability to maintain flight without a loss of altitude. This uncoordinated maneuver, coupled with high airspeed (140 KIAS) and low altitude (110 feet AGL), made it impossible to recover control of the aircraft prior to ground impact.

The PC had received no formal training or evaluation to ensure he was qualified to perform the maneuvers which were performed during the flight demonstration. Past training consisted of performing the flight duties as a copilot during previous demonstrations and having the maneuvers being demonstrated while in flight school. Additionally, there were unauthorized passengers on-board the aircraft during the flight. It is critical that aviators maintain good flight discipline before and during a mission and it is also critical the units develop training programs to adequately develop, assess, and certify aviators in performing high risk operations like maneuvering flight.

Class A – C Mishap Tables

Manned Aircraft Class A – C Mishap Table										as of 25 Jul 16
	Month	FY 15					FY 16			
		Class A Mishaps	Class B Mishaps	Class C Mishaps	Fatalities		Class A Mishaps	Class B Mishaps	Class C Mishaps	Fatalities
1st Qtr	October	0	1	3	0		1	3	7	0
	November	2	0	2	2		2	1	1	6
	December	1	1	3	0		1	1	4	2
2nd Qtr	January	2	0	6	0		0	0	3	0
	February	0	0	0	0		1	1	3	0
	March	2	1	10	11		1	3	2	0
3rd Qtr	April	0	1	1	0		0	0	3	0
	May	1	3	5	0		0	1	5	0
	June	1	0	8	0		1	0	2	0
4th Qtr	July	2	3	7	0				2	
	August	2	1	3	0					
	September	1	1	3	0					
	Total for Year	14	12	51	13	Year to Date	7	10	32	8
Class A Flight Accident rate per 100,000 Flight Hours										
5 Yr Avg: 1.28		3 Yr Avg: 1.25				FY 15: 1.52			Current FY: 0.91	

UAS Class A – C Mishap Table									as of 25 Jul 16
	FY 15					FY 16			
	Class A Mishaps	Class B Mishaps	Class C Mishaps	Total		Class A Mishaps	Class B Mishaps	Class C Mishaps	Total
MQ-1	3	2		5	W/GE	9			9
MQ-5	1		1	2	Hunter	2			2
RQ-7		5	8	13	Shadow		4	5	9
RQ-11			1	1	Raven			3	3
RQ-20					Puma				
YMQ-18									
SUAV					SUAV				
UAS	4	7	10	21	UAS	11	4	8	23
Aerostat	1	0	0	1	Aerostat	2	1		3
Total for Year	5	7	10	22	Year to Date	13	5	8	26

Accident findings: From the archives for your review

FINDING (Present and Contributing: Human Error): While engaging enemy combatants during a Quick Reaction Force (QRF) mission, the pilots became fixated on the targets while conducting diving fire. The aircraft was maneuvered at a high airspeed and rate of descent below a recoverable altitude and impacted the ground. The crew members were fatally injured and the aircraft was destroyed.

FINDING (Present and Contributing: Suspect Human Error): During the conduct of a continuation training flight, the IP failed to accurately judge rate of closure with the terrain and make the appropriate control inputs to maneuver the aircraft to avoid the terrain. The IP failed to allow sufficient recovery altitude based on aircraft weight and density altitude which caused the aircraft to develop an unrecoverable sink rate from the altitude at which they were operating. The aircraft crashed into the terrain. Both crew members received fatal injuries and the aircraft was destroyed.

FINDING (Present and Contributing: Human Error): While conducting scout weapons team (SWT) tactics and high-altitude flight/maneuvering training the PC applied excessive forward cyclic and placed the aircraft into a 41- degrees dive, exceeding the aircraft's maneuver limitations of a 30-degree pitch angle. This caused an increase in airspeed and rate of descent at a low altitude. Aircraft then crashed into a canyon. The crew received minor injuries and the aircraft was destroyed.

FINDING (Present and Contributing: Human Error): While conducting a day escort and aerial security/reconnaissance mission, Chalk 1 of a flight of two AH-64Ds elected to perform a pitch-back turn over a combat outpost (COP) in response to a request for a low-pass. The aircraft commander chose to perform and execute this action at a low AGL altitude and at a pressure altitude of 9,000 feet mean sea level (MSL). The aircraft struck the ground and was destroyed. One of the crew members received serious injuries.

FINDING (Present and Contributing: Human Error): While conducting a day, QRF combat mission, the AH-64 PC failed to properly estimate distance, closure, and required control inputs. When alerted by the front seat pilot that they were closing with the UH-60 aircraft in their flight, the PC failed to estimate the amount of control inputs required to avoid the aircraft. Instead, he initiated an abrupt, steep, and descending bank in contravention of the requirements for maintaining basic aircraft control. When the PC attempted to recover from the steep bank, the rotor RPM began to decay and the aircraft impacted the ground. The impact destroyed the aircraft and injured both pilots.

FINDING (Present and Contributing: Human Error): While conducting combat maneuvering flight, specifically a cyclic climb to a push-over break, the PC failed to estimate the amount of control input required to properly maneuver the aircraft. The PC over controlled the aircraft by exceeding the flight envelope (inappropriate flight attitude) and allowing a high sink rate to develop with insufficient altitude for recovery.

FINDING (Present and Contributing: Human Error): When directed by the PC to make a hard right turn, the PI applied control inputs that put the aircraft into a flight profile beyond the crew's ability to recover for the altitude and airspeed flown. The aircraft descended rapidly and impacted the ground causing minor injuries to the crew and extensive damage to the aircraft.

FINDING (Present and Contributing: Human Error): The PC was unaware of the aircraft limits and initiated a 60-degree right bank angle with a 24-degree nose low attitude and was not able to recover due to insufficient altitude and exceeding aircraft performance limitations. The aircraft was destroyed and the crew was injured.

FINDING (Present and Contributing: Human Error): While performing combat maneuvering flight (CMF) the IP placed the aircraft into an 87 degree left bank at an altitude of approximately 200 feet above ground level, an altitude insufficient to recover from the maneuver. The aircraft descended and contacted a tree. The aircraft was destroyed and the crew received fatal injuries.

"You've got to know what you're doing." SPC Smith quote

Those were the words penned on a kneeboard size sheet of paper that hung on the standardization officer's wall. Familiar with the crew chief and being somewhat inquisitive, I asked the SP the background to the innocuous quote and why it garnered a coveted location. The story wasn't all that impressive. It seems the SP and a certain crew chief were on a muti-ship mission to pick up vehicle sling-loads. Apparently the ground element had the PZ a bit disorganized which led to the flight lead having some problems getting the formation into position. There were also some frustrated loads which led to frustrated aircrews.

Anyway, as with any of us in a situation like this, the crew was talking among themselves on how things were screwed up and what lead, the AMC and/or the ground unit should be doing to fix it. Backseat driving as it were. Somewhere in this interchange the crew chief uttered the phrase "you've got to know what you're doing" in reference to the outside activities. "Brilliant!" the SP immediately announced. "You've got to know what you're doing," the SP repeated in an elevated tone. "That's so insightful I'm going to write it down and use it to guide my activities for the rest of my life" or words to that effect and, based on personality, I'm sure was tainted with more than a bit of sarcasm. There was probably more levity involved but that was how the note was born.

So why take a lengthy introduction to what seemingly is a common sense statement? In about a three month time period the Army lost two UH-60s and four crewmembers conducting training in combat maneuvering flight (CMF). Both involved excessive maneuvering at an altitude from which the aircraft could not be recovered before impacting the trees. In simple terms, they were trying to do the maneuvers too low for the conditions in which the aircraft was operating.

I'm not going to embark on a class on power management and aggressive flight maneuvers. Mostly because my aerodynamic knowledge has concentrated on the concept of houses get smaller when you increase collective and houses get bigger when you decrease collective. But you have to know some of the basics before entering into those high bank angle flight conditions. Notice I referred to high bank angle flight conditions, not CMF. That's my first point. You have to think broader than just the task number found in your ATM and the associated type of turns, climbs and dives. It's all maneuvering flight and the principles apply whether it's CMF, CMF training or conducting a steep turn to reverse course in the training area.

The ATM gives a pretty good description of CMF and includes the warnings described in the DES article in this issue. Outside the cited warnings there are also tidbits interjected into the various descriptions such as "the PC must ensure the crew is aware of the effects of the environmental conditions on flight performance" and "aircrews must be familiar with aerodynamic factors such as mushing, transient torque, and blade stall before performing these maneuvers." There are also notes on recommended airspeeds and altitudes when training the maneuvers. These aren't new or specific to CMF, but must be considered in any of your flight tasks.

What seems to be missing in the task description is a specific reference point from which to base your calculations. Yes, it is important to know the aerodynamic factors associated with the flight regime you are operating in so you will know the cause and effects that will happen to your machine. In Chapter 1, section VI Maneuvering Flight, FM 3-04.203, there is a sub-section titled High Bank Angle Turns. An extract follows on the next page.

Continued on next page

HIGH BANK ANGLE TURNS (FM 3-04.203 Fundamentals of Flight)

As the angle of bank increases, the amount of lift opposite the vertical weight decreases (figure 170). If adequate excess engine power is available, increasing collective pitch enables continued flight while maintaining airspeed and altitude. If sufficient excess power is not available, the result is altitude loss unless airspeed is traded (aft cyclic) to maintain altitude or altitude is traded to maintain airspeed.

At some point (airspeed/angle of bank) sufficient excess power will not be available and the aviator must apply aft cyclic to maintain altitude (table 1-3). The percentages shown are not a direct torque percentage, but percentage of torque increase required based on aircraft torque to maintain straight and level flight. If indicated cruise torque is 48 percent and a turn to 60 degrees is initiated, a torque increase of 48 percent (96 percent torque indicated) is required to maintain airspeed and altitude.

Bank Angle versus torque

Bank Angle - Degree	Increase in TR - Percent
0	---
15	3.6
30	15.4
45	41.4
60	100.0

Table 1-3

This chart is my second point. Notice that at a 60 degree bank angle (2 G) it requires a 100 percent increase in power to maintain your airspeed and altitude in the turn. That's simple Jethro Bodine math you can do in the cockpit. What isn't simple is the more complex math required to determine how much of a trade-off in pitch attitude and airspeed is needed to maintain your altitude when you don't have double the power available. That comes with experience gained through practice of the maneuver. Additionally, when you have to cipher in environmental factors, blade stall and other attributes, you end up guestimating what inputs are needed to get the desired results. Terrain flight altitude is not where you want to be practicing your guestimates. One more thing on the chart: What is not depicted is the steep increase in G loading beyond the 60 degree point. It is very important for the non-flying pilot to ensure that bank angles are not exceeded.

Anther important item from your PPC: **MAX ANGLE**. Value derived from the AIRSPEED FOR ONSET OF BLADE STALL chart in the aircraft operator's manual, chapter 5. While not a limitation, the value provides the level flight angle of bank at which blade stall will begin to occur as a function of airspeed, gross weight, PA, and temperature. Keep that in mind when picking your bank angles.

When you get the chance, look over a copy of The Army Aviator's Handbook for Maneuvering Flight and Power Management, dated March 2005. It gives a good overview of what you need to know and how to apply it. It also has some common sense maneuvering flight rules of thumb (next page) which can be more helpful than **"you've got to know what you're doing."**

Jon Dickinson, Aviation Directorate

SECTION III. Maneuvering Flight Rules of Thumb

1. Never move the cyclic faster than you can maintain trim, torque and rotor. If you enter a maneuver and the trim, rotor or torque reacts quicker than you anticipated, then you have exceeded your own limitations. If you continue on this path, you will most likely exceed an aircraft limitation. Slow down and perform the maneuver with less intensity until you can control all aspects of the machine.

2. Anticipate changes in aircraft performance due to loading or environmental condition. The normal collective increase to check rotor speed at sea level standard (SLS) will not be sufficient at 4,000 ft. PA and 95 degrees Fahrenheit (4K95).

3. Anticipate the following characteristics during maneuvering flight and adjust or lead with collective as necessary to maintain trim and torque:

   a. During aggressive left turns, torque increases.

   b. During aggressive right turns, torque decreases.

   c. During aggressive application of aft cyclic, torque decreases and rotor climbs.

   d. During aggressive application of forward cyclic (especially when immediately following aft cyclic application), torque increases and rotor speed decreases.

4. Always leave yourself a way out. Regardless of the threat, the ground will always win a meeting engagement.

5. Know where the winds are.

6. Most engine malfunctions occur during power changes.

7. If you haven't performed combat maneuvers in a while, start slowly. Much like NVD flying, your cross check slows and it will take some time to develop proficiency at tasks that have not been performed for extended periods of time.

8. Crew coordination is critical. Everyone needs to be fully aware of what is going on and each crewmember has a specific duty.

9. In steep turns the nose will drop. In most cases you must trade energy (airspeed) to maintain altitude as you may not have the required excess engine power (i.e., to maintain airspeed in a 2G/60-degree turn you will have to increase rotor thrust/engine power by 100 percent). Failure to anticipate this at low altitude will endanger yourself, your crew and your passengers. The rate of pitch change will be proportional to gross weight and DA.

10. Many maneuvering flight over-torques occur as the aircraft unloads Gs. This is due to insufficient collective reduction following the increase to maintain consistent torque and rotor as g-loading increased (i.e., dive recovery, recovery from high-g turn to the right)

Stop looking for levity or humor in these white spaces. As previously mentioned, this space will be restricted to content that is aligned to its core purpose of preventing accidental loss.

Selected Aircraft Mishap Briefs

Information based on preliminary reports of aircraft mishaps reported May – June 2016.

Attack helicopters

H-64D 

-During conduct of autorotation training the aircraft contacted the runway causing damage to the gun cradle and aircraft underside. (Class B)

-Following take-off the aircraft experienced a No. 2 engine high side failure. Crew executed emergency procedure and landed without further incident. (Class C)

-Crew experienced caution lights for multiple aircraft systems accompanied by a vibration. Aircraft was landed. (Class C)

Utility helicopters

H-60 

-M Series. During hoist training SM fell approximately 20’ sustaining serious injuries. (Class A)

-L Series. Hoist cable/motor malfunction resulted in detachment of the cable from the hoist. 600 lb concrete load descended to ground impact. (Class C)

-A Series. Crew was taxiing out of the parking pad for a flight mission when the aircraft’s main rotor blades made contact with the tail rotor of the aircraft parked in the adjacent pad. Damage was sustained to all blades involved: All 4 MRB of the moving aircraft and one sheared T/R blade from the parked aircraft.

Cargo helicopters

CH-47D 

-Left side escape hatch blew out during an IFR flight. (Class C)

Fixed-wing

MC-12S 

-Lightning strike to the left prop occurred in flight. (Class C)

Unmanned Aircraft Systems

RQ-7B 

-System experienced engine TEMP spike as crew was attempting to set the TALS. System subsequently lost altitude and impacted on the range. (Class B)

-Crew lost link with the UAS on climb-out and shortly following an un-commanded descent. System crashed and was recovered with significant damage. (Class B)

-Crew experienced a system generator failure during its approach to land. Recovery chute was deployed and system was recovered with damage. (Class C)

-System crashed off the landing strip after the arresting cable reportedly failed (snapped), releasing the safety net prematurely. Main landing gear contacted uneven terrain/ruts and separated. Damage reported to the undercarriage and payload. (Class C)

-System experienced a completed engine-failure during flight and descended to ground-impact. System was recovered with damage. (Class C)

MQ-1C 

-Crew reportedly experienced an engine failure. Crew ultimately lost link at 1K’ AGL, while attempting to guide the UAS to landing. System was located in the training area and deemed destroyed. (Class A)

-System reportedly experienced an engine RPM exceedance, lost altitude and impacted the ground. Wreckage components were recovered. (Class A)

-System experienced an engine failure and subsequent loss of altitude until impact with the ground. (Class A)

Continued on page 14

Density altitude. . . a critical hot weather consideration 17 May 1978 Flightfax

To many aviators density altitude is something periodically mentioned in weather briefings that signifies decreased aircraft performance. While most aviators are aware of this fact, few really understand the disastrous effects that high density altitudes can have on aircraft performance unless they have encountered the problem. Consequently, year after year density altitude is listed as a factor in aircraft accidents.

While technique is important, the only way an aviator can be completely sure his aircraft is capable of performing a mission under high gross weight conditions is to consult the operator's manual performance charts. Often these performance charts, which required a great deal of research, testing, and money to compile, go unused because of the time and effort required to check them. As a result, many aviators proceed with a potentially critical mission in high density altitude conditions based on skill alone. This places the aviator in a precarious position which can result in a costly accident. However, it is only through knowledge and its proper application that we can successfully combat the problems of high density altitude.

Three factors

Air, a mixture of gases, occupies space and has mass; therefore, density. Density, or the concentration of molecules, determines the ability of air to support. The thicker, more dense it is, the greater its support capability. Air density is affected by three main factors: temperature, pressure, and humidity. Of these, temperature and pressure have the most adverse effect. When air undergoes a drop in pressure or a rise in temperature, expansion takes place and the air molecules move away from each other. Air density decreases and so does its ability to support. The reverse holds true if pressure rises or temperature decreases. Humidity has a similar effect as moisture displaces air, making humid air lighter or less dense than an equal volume of dry air.

This relationship of pressure, temperature, and humidity of air establishes density altitude. For practical purposes, we can express density altitude as the relative altitude or load-lifting ability of air as it expands and contracts. At times, this expansion and contraction seem unbelievable. At one Army post, for example, the actual elevation ranges from 300 to 500 feet above sea level. Depending on weather and time of day, the density altitude may vary from minus 1,000 feet to plus 4,000 feet. Consider that a UH-1H at a gross weight of 9,500 pounds can clear a 50-foot obstacle with a zero ground run (vertical takeoff) under standard (15° C.) sea level conditions. With a temperature rise to 35°C. the aircraft will require a takeoff distance of 255 feet and an airspeed of 20 knots to clear the same obstacle.

Since lift is not only dependent on the shape of an airfoil and angle of attack but also on the mass of air causing the lifting force, as density altitude becomes greater, lift decreases. In helicopters, high density altitude has the same effect as loss of rotor rpm. For example, power trains can be over-torqued, reciprocating engines can be over-boosted, and autorotations can become especially critical when pilots attempt otherwise normal maneuvers under high density altitude conditions.

Engine performance affected

Low density air (high density altitude) also affects engine performance . While the volume of air

Continued on next page

Blast From The Past continued from previous page

flowing through a gas turbine engine may remain constant at high density altitudes, this thinner air contains less mass, and thrust (power) is lost. A temperature of 100° F., for example, reduces the efficiency of a gas turbine engine by approximately 15 percent from that under standard conditions of 59° F.

During hot weather, density altitude changes are rapid, frequent, and great. The load you take off with at dawn may well be beyond the capability of your aircraft an hour later. Density altitude must not only be computed for takeoffs, but also equally important, for destination landings. This is particularly true if you are taking off from a low altitude and plan to land in high terrain. And, in particular, extra caution is a must for autorotations.

Steps to take

With this in mind, your aircraft will do all it is asked to do and come home safely even on the hottest day if you (1) compute density altitude BEFORE weight and balance, (2) always assume density altitude to be higher than it probably is, (3) study your operator's manual density altitude tables, and (4) act accordingly.•

Continued from page 12

Selected Aircraft Mishap Briefs -cont.

Information based on preliminary reports of aircraft mishaps reported May and June 2016.

<u>**Unmanned Aircraft Systems**</u> – cont.

MQ-1C

System reportedly entered an un-commanded descent, followed by a decrease in manifold pressure. Crew reportedly responded to a Turbo-charger Failure and initiated RTB procedures but were unable to maintain altitude sufficient for landing. Wreckage was recovered. (Class A)

MQ-5B

-UAS reportedly lost power and crashed on short-final (approach), during an attempted return to base. (Class A).

Aerostat

-PTDS was aloft when the tether reportedly 'snagged' and snapped in sudden wind-gust shifts. Crew employed the FTS and system was recovered. (Class A)

U.S. ARMY
COMBAT READINESS CENTER

Online newsletter of Army aircraft mishap prevention information published by the U.S. Army Combat Readiness Center, Fort Rucker, AL 36322-5363. DSN 558-2660. Information is for accident prevention purposes only. Specifically prohibited for use for punitive purposes or matters of liability, litigation, or competition. Flightfax is approved for public release; distribution is unlimited.

If you have comments, input, or contributions to Flightfax, feel free to contact the Aviation Directorate, U.S. Army Combat Readiness Center at com (334) 255-3530, DSN 558-3530